# FINAL REPORT
and
# RECOMMENDATIONS
of the
COMMITTEE
on
ONTARIO'S FUTURE
MINING EDUCATIONAL NEEDS

April, 1987

Ontario

Ministry of
Northern Development
and Mines

(416) 965-1669

April 9, 1987

The Honourable David Peterson
Premier and Minister of
Northern Development and Mines
Legislative Building
Queen's Park
Toronto, Ontario

Dear Mr. Peterson:

On October 20, 1986, a committee was established to review the future education and training needs of Ontario's mining industry.

The committee has completed the review and we are pleased to submit our report.

Yours sincerely,

Bruce Ross
Chairman
Mining Education and Training Needs
Review Committee

cc: The Honourable Gregory Sorbara
Minister of Colleges and Universities

Mr. John Gordon, President
Ontario Mining Association

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# ONTARIO's FUTURE MINING EDUCATIONAL NEEDS

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# EXECUTIVE SUMMARY

## 1.1 Rationale For The Report:

The purpose of this report is to review:

- The future skills and knowledge requirements of the mining industry.
- The educational and training programs available now.
- The identification of any gaps or deficiencies of these programs in relation to the anticipated future needs of the industry.
- The match between current and future industry needs for professional and technical people and the number of graduates being produced by Ontario's mining schools.
- The strategies for meeting the mining industry's future need for highly qualified professional and technical people.

## 1.2 Methodology:

The review was carried out in close consultation with the mining industry, educational institutions and the Ontario Mining Association (OMA). Meetings were held with the province's major mining companies, educational institutions offering mineral programs, and labour unions. In addition, a survey of Ontario's mining companies and post-secondary institutions offering mining programs, was undertaken. To supplement the collection of primary data, existing sources of secondary information were consulted.

## 1.3 Broad Study Parameters:

(a) While the primary emphasis of the review was on the changing needs of the Ontario mining industry and the programs offered by Ontario educational institutions, developments in other jurisdictions were also scrutinized on a selective basis.

(b) The review focused primarily on the mining and milling components of the Ontario mining industry.

(c) The needs of both metal mining and the industrial minerals industry were examined.

(d) The review assesed the post-secondary educational and training needs of the mining industry over the next 5-10 years.

(e) The study considered the recommendations of the provincial inquiry into Ground Control and Emergency Preparedness in Ontario mines.

(f) Input was sought from Ontario's mining companies and those post secondary educational institutions offering mining educational or training programs. Labour unions were consulted and written briefs were accepted from all interested parties.

## 1.4 Management of the Review

(a) Preamble

Extensive consultation was held with the OMA concerning appropriate industry representation during the review. It was concluded that an industry representative would act as a full-time

chairman of an advisory committee consisting of representatives of Ontario's colleges and universities and senior government officials with research assistance provided, as needed, by staff drawn from several ministries.

Mr. Bruce Ross, a past president of the OMA, was nominated by the OMA and appointed by Premier Peterson in October of 1986 when the Committee was established.

A retired mining engineer and former mining company executive, Mr. Ross is currently the President of the Canadian Institute of Mining and Metallurgy. He is also a past President of the Association of Professional Engineers of Ontario.

Mr. Ross was responsible for devising the methodology to be employed during the review, for consulting the Province's mining companies, for confering with the educational institutions offering mining programs and for consulting other interested parties such as labour unions and the mining industry service companies. Mr. Ross assessed the information collected during the review and prepared the report.

Dr. Ken Sharratt of the Ministry of Northern Development and Mines was secretary to the review.

c) Advisory Committee

An advisory committee comprising of a representative from Ontario's Colleges and Universities as well as senior government officials was established to assist Mr. Ross. The Committee met several times and provided advice on the operation of the Province's educational institutions. The Committee's membership was as follows:

Dr. Ralph Benson, Assistant Deputy Minister, College Affairs and Student Support Division, Ontario Ministry of Colleges and Universities, Toronto.
Mr. Dennis Tieman, Assistant Deputy Minister, Mines and Minerals Division, Ontario Ministry of Northern Development and Mines, Toronto.
Ms. Mary Hofstetter, Vice President, Academic, Mohawk College, Hamilton.
Dr. Ed Monahan, Executive Director, Council of Ontario Universities, Toronto.
Mr. Vic Pakalnis, Director, Mining Health and Safety Branch, Ministry of Labour, Toronto.

d) Research Support Staff

Staff from several government ministries collected background information, and also analyzed the questionnaires received from the mining companies, the Province's educational institutions offering mining programs, and the graduates of the programs at Haileybury and Queen's. The assistance provided by the following people was appreciated.

Mr. David Antle, Ministry of Northern Development and Mines
Mr. Cal Warden, Ministry of Northern Development and Mines
Mr. Lorne MacKenzie, Ministry of Colleges and Universities
Mr. Ed Trelford, Ministry of Labour

## 1.5 Recommendations:

- To ensure that the long-term educational and training needs of the industry are met, much closer cooperation among institutions (both community colleges and universities) is needed in order to maximize existing resources, and accommodate long-term changes in demand with little disruption.

- Mining engineering programs at Queen's and Laurentian should be continued in order to provide for a potential increase in demand for engineers. Enrollments should be reviewed in five years to determine whether both programs should be retained.

- The current cooperation between Queen's and Laurentian to strengthen their rock mechanics programs should be encouraged in other undergraduate courses to make better use of staff and facilities at the two institutions.

- The mining related engineering programs at the University of Toronto and the University of Waterloo prepare graduates for a variety of careers including mine operations. For this reason, these programs should be continued.

- Universities and colleges should establish and maintain active advisory committees that maintain close contact with the mining industry for the purpose of determining its views about the appropriateness of instructional programs in meeting the needs of the industry.

- The mining related programs at Cambrian College and the programs at Haileybury should be brought together to form an Ontario Institute of Mining Technology. It is proposed that this Institute be administered by Cambrian College. Special governance provisions which include representatives from industry, the Ministry of Colleges and Universities and the Ministry of Northern Development and Mines should be established to ensure the viability of both campuses.

- The establishment of the Ontario Institute of Mining Technology should be seen as the first phase in the development of a national centre of excellence in mining education and should be reviewed continually by government to determine how well the relationship is working. It is possible as part of phase II, that links could be established between the Ontario Institute of Mining Technology and the evolving centre of mining excellence at Laurentian University.

- Programs at Sir Sandford Fleming College should be continued because they serve other industries.

- Courses in occupational health and safety, maintenance, and management skills should be increased in range and frequency.

- Universities and colleges should work more closely with industry to determine the needs for short-term non-credit courses aimed at up-grading the knowledge and skills of industry personnel. They should be prepared to deliver such courses at the home campus, at remote locations, by correspondence or by distance education facilities, as may be appropriate.

- Each university and college should designate a person to determine the nature and scope of short courses in rock mechanics and ground control which are required to train engineers, technologists and workers employed currently by the industry.

- The universities and colleges should design courses to specifically address the training needs for each type of employee. Delivery of the courses should accommodate the convenience of the mining companies as far as possible, having regard for the facilities required for instruction and the numbers of attendees available.

- The universities and colleges should actively consider ways in which they can contribute to improving the work experience component of their programs.

- To this end, each institution should appoint a resource person, either full or part-time as appropriate, to stimulate and coordinate the work experience component.

- Ontario employers and government should recognize the importance of work experience in the training of students and devise ways to provide meaningful employment opportunities for students. One or more members of a company's staff should be designated to liaise with students during the work term.

# II SUPPLY AND DEMAND FOR GRADUATES

## 2.1 Industrial Performance

Employment in Ontario's mining industry has dropped substantially, from approximately 42,000 in 1971 to approximately 26,000 in 1986. In spite of the current economic recovery, employment in the industry is expected to contract further, while production levels have been slow to recover. A number of factors have contributed to this development.

Traditional markets for metal producers have come under increased competition as producers and consumers of finished goods and services adjust to global economic and environmental conditions. For example, automobile producers have downsized and substituted plastics and fiber-glass for metal in an attempt to maximize fuel efficiency. Lead additives to fuel have been eliminated on most new cars to assist in the fight against air pollution. Along with environmental and economic change, technological advancements have resulted in the substitution of man-made items for metal products, like the substitution of fiber optics for copper in long distance communication networks.

The ability and desire to substitute other materials for minerals in the production of finished goods and services has resulted in increased competition in many of the traditional markets for metallic minerals. One exception to the rule has been the increase in the demand for gold. As long as the price remains at or above $300 U.S., gold mining in Canada will likely continue to experience growth and expansion. If the price should drop, overall production would level-off.

With the increase in global manufacturing, the direct linkage between industrial production and the demand for mineral products produced in North America, and in Ontario, has weakened. This situation has been intensifed by the entry of less developed countries into mineral production. The end result has been a substantial increase in the number of mineral suppliers in an era when the demand for their products is flat. Many of the mining sub-sectors are facing conditions of excess capacity to produce, which has forced mineral producers to modernize their facilities and to shed labour in order to remain competitive.

## 2.2 Employment Opportunities

With ongoing technological change and existing structural adjustment, employment opportunities in Ontario mining are not expected to rebound quickly over the next four to five years. Improving productivity in the Ontario mining industry has resulted in substantial labour shedding since the 1981-82 recession, and is expected to continue over the next five years.

Although overall employment is expected to drop, the employment of professionals within the mining industry is projected to remain stable over the same period. Therefore, the proportion of professionals in relation to the total labour force is increasing -- a trend that is likely to continue as the industry adopts new technologies. Given this structural change in the labour force, what must now be examined is whether or not the current and future industry needs for professional and technical people are in line with the number of graduates being produced by Ontario's mining schools.

## 2.3 Demand And Supply For Mining Graduates

To determine the current and future human resource needs of the industry, a survey of Ontario mines was undertaken. When this data was compared with the number of graduates produced from both community colleges and universities, certain conclusions could be drawn.

Over the past five years approximately 150 graduates in engineering fields of study related to mining were hired in Ontario, with the largest proportion of these being mining and metallurgical engineers. An examination of Ontario university graduates from mining and metallurgical engineering programs reveals that the supply of these professionals exceeds Ontario's demand. For instance, for a five year average from 1981-86, the supply of mining engineers graduating from Ontario institutions exceeded the number of graduates hired directly by Ontario mining producers by approximately 4:1, and for metallurgical engineers it was nearly 20:1.

It may appear at first glance that the situation is one of substantial over-supply, yet when one adjusts for a leakage of graduates to other provinces and industries servicing the mining sector, the imbalance between supply and demand is not nearly as great. Nevertheless, with university enrollment in mining and metallurgical engineering on the rise again in the mid-1980's, and with industrial demand for these professionals remaining relatively flat, the current gap between supply and demand could widen.

At the community college level in Ontario, the number of graduates in mining-related studies also outpaced demand. Over a five year period from 1980-85, community colleges in Ontario have produced 243 mining technicians and 235 graduates in mining technology. Once again the supply of technologists and technicians in mining exceeds the needs of Ontario mines.

The survey of mining companies indicated that from 1981 through to 1986, roughly 80 mining technicians and technologists were hired in Ontario, leaving a very substantial portion of graduates to seek employment in other provinces, in industries servicing the mining sectors, or to leave the industry.

The outlook over the next five years is likely to remain unchanged, with Ontario-trained graduates in mining-related fields of study exceeding the provincial demand. An examination of both the community colleges and universities active in mining-related courses indicates that the existing physical facilities could easily accommodate double the enrollments in many of their programs. Ontario post-secondary institutions involved in mining are operating at about half capacity. Even at this level, post-secondary institutions are turning out graduates at a pace that exceeds their demand in Ontario.

It is clear that existing Ontario institutions will be able to meet any foreseable increase in demand for graduates over the next five years. What is not so clear is whether or not the training techniques and equipment available to students will match the needs of the overall industry as it undergoes substantial technological changes and specialization. One reason for this is that some institutions lack the necessary student body to either warrant or support the expenditures needed to update their programs and purchase new equipment.

## 2.4 SUMMARY

The mining industry in Ontario as a whole, has not recovered to pre-recession levels. Employment continues to drop in many of the industry's sub-sectors. One exception to this trend is gold mining, where, if the price remains at its current level or rises, additional expansion can be expected. As one would expect, the enrollment in mining-related courses varies with the health of the industry. Over the last five years, enrollment in mining-related programs in community colleges has fallen by 30-50%. However, due to the time lag between enrollment and graduation the actual number of graduates coming from the communitiy college system still remains above pre-recession levels. Consequently, the number of graduates available to service the Ontario mining industry is likely to continue to substantially exceed demand.

For universities, the picture is much the same. The number of graduates from mining-related courses remains near pre-recession levels with enrollments reaching their lowest point in 1981-82.

Currently, the mining industry has a large and well-trained pool of post-secondary graduates from which to chose. With the exception of a few specialized fields, the current and future manpower needs of the mining industry can easily be met by existing educational facilities.

## 2.5 RECOMMENDATION

2.5.1 To ensure that the long-term education and training needs of the industry are met, much closer cooperation among institutions (both community college and universities) is needed to maximize existing resources, and accommodate long-term changes in demand with little disruption.

## III CURRENT STATUS OF PRESENT UNIVERSITY AND COLLEGE PROGRAMS

As a result of discussions with staff members and inspection of facilities the following opinions were formed of the mining related programs offered by the universities and colleges in Ontario.

### 3.1 Universities

3.1.1 Laurentian offers programs at the undergraduate level in extractive metallurgy and mining engineering. Mineral processing is accredited by the Canadian Accreditation Board; accreditation of the mining program is expected during 1987. Currently staffing is marginally adequate, while space and equipment are inadequate. Plans are in hand to improve these facilities and financing is being made available. A chair is being established for rock mechanics; an agreement is being made with Queen's to provide for cooperation in research and teaching of this subject. To improve communication between the institution and industry, plans are underway to reactivate an advisory committee to liaise with industry.

3.1.2 Queen's offers programs at the graduate and post graduate levels in mining engineering and a mineral process option. The undergraduate programs are accredited by Canada Accreditation Board (CAB). It appears that staffing physical facilities and finances are adequate. Currently the relationship with industry is maintained through an active advisory committee.

3.1.3 University of Toronto offers programs at the undergraduate and graduate levels in geo-engineering with three options available - mineral exploration, geotechnical and mineral engineering. The undergraduate program is accredited by CAB, and staffing, physical facilities and finances are adequate.

3.1.4 The University of Waterloo offers programs in geological engineering at the undergraduate and graduate levels.
The undergraduate program is accredited by CAB, and staffing, physical facilities and finances are adequate.

## 3.2 Colleges

3.2.1 Cambrian offers programs for:

(i) Mining Engineering Technology
(ii) Mining Engineering Technician
(iii) Geology Engineering Technology
(iv) Geology Engineering Technician
(v) Metallurgy Engineering Technology
(vi) Metallurgy Engineering Technician
(vii) Instrumentation Engineering Technology
(viii) Instrumentation Engineering Technician

Staffing, physical facilities and financing are adequate, and the relationship with industry is maintained through an active advisory committee. There is good rapport with and support by the college administration.

3.2.2 Northern (Haileybury Campus) offers programs for:

(i) Mining Technology
(ii) Mining Technician
(iii) Maintenance Technology
(iv) Maintenance Technician
(v) Instrument Technician

Physical facilities could easily accommodate double the present enrollment. However, staffing should be reviewed and additional funding has been required due to low enrollment. Currently, relationships with industry are maintained through an active advisory committee. Haileybury also has a very active alumni association. It is evident that the relations between the Northern College Board and the Administration at the Haileybury campus are strained.

3.2.3 Sir Sandford Fleming offers a program for:

(i) Geological Technician - Geotechnical and Minerals option
(ii) Geological Technology
(iii) Minerals Engineering Technology

Their physical facilities and staffing are adequate. A substantial portion of their graduates usually obtain employment in positions other than those related to mine production and mineral processing. The administration supports the program.

## 3.3 Recommendations

3.3.1 Mining engineering programs at Queen's and Laurentian should be continued in order to provide for a potential increase in demand for engineers. Enrollments should be reviewed in five years to determine whether both programs should be retained.

3.3.2 The current cooperation between Queen's and Laurentian universities to strengthen their rock mechanics programs should be encouraged in other undergraduate courses to make better use of staff and facilities at the two institutions.

3.3.3 The mining-related programs at the University of Toronto and the University of Waterloo prepare graduates for a variety of careers including mine operations. For this reason, these programs should be continued.

3.3.4 Universities and colleges should establish and maintain active advisory committees that maintain close contact with the mining industry for the purpose of determining its views about the appropriateness of the instructional programs in meeting the needs of industry.

3.3.5 The mining related programs at Cambrian College and the programs at Haileybury should be brought together to form the Ontario Institute of Mining Technology. It is proposed that this Institute be administered by Cambrian College. Special governance provisions which include representation from industry, the Ministry of Colleges and Universities and the Ministry of Northern Development and Mines should be established to ensure the viability of both campuses.

3.3.6 The establishment of the Ontario Institute of Mining Technology should be seen as the first phase in the development of a national centre of excellence in mining education and should be reviewed continually by government to determine how well the relationship is working. It is possible as part of phase II, that links could be established between the Ontario Institute of Mining Technology and the evolving centre of mining excellence at Laurentian University.

3.3.7 Programs at Sir Sandford Fleming College should be continued because they serve other industries.

# IV ADEQUACY OF PRESENT PROGRAM

## 4.1 Opinions of Mining Industry

Thirty-four operating mines in Ontario were asked to reply to a questionnaire regarding the adequacy of the education received by recent graduates. This was complemented by interviews with senior management at 14 mines. In addition, interviews were conducted with 5 contractors, engineering consultants and suppliers who employ mining engineers and technologists. Personnel from the Mine Safety Branch, Mines Accident Prevention Association of Ontario and Canada Centre for Minerals and Energy Technology were also interviewed.

Employers were unanimous in stating that they are experiencing no difficulties in obtaining adequate numbers of well-trained mining engineers and technologists, and do not expect any difficulties in the forseeable future. These companies were also unanimous in stating that the training of recent graduates is generally adequate. A number of companies reported that the training in some subject areas could be strengthened. These included rock mechanics, management skills, maintenance of equipment, and safety and health practices. A few companies reported difficulties obtaining an adequate number of mineral processing engineers and technologists, and instrument repair technicians.

## 4.2 Opinions of Graduates

Current mailing addresses for graduates during the last five years were obtained from Queen's and Haileybury. A questionnaire was mailed to each graduate; replies were received from approximately 50% of the graduates from each institution. Laurentian and Cambrian were unable to supply current mailing lists.

The questionnaire requested the graduate to describe the type and location of employment since graduation, to list the subjects studied which were most useful in employment and to list subjects which were not studied but would have been useful in subsequent employment.

In regards to the most useful courses taken; Queen's graduates mentioned nearly every subject. The most frequently mentioned subjects, in descending order of importance, were:

- underground mining
- fluid mechanics
- blasting
- mineral process design
- surveying
- ventilation
- open pit mining
- rock mechanics
- computer applications
- soil mechanics
- chemistry
- industrial organization
- mine valuation
- drawing
- geology.

A number of respondents expressed a desire to have had more instruction in computer programming, management and cost control, mine valuation, report writing, practical rock mechanics and occupational health and safety. Several Queen's graduates commented that there should have been more emphasis on case studies and a larger number of lectures by people from industry with practical experience.

The responses from Haileybury graduates concerning the most useful courses taken listed nearly every course at least once, but the courses mentioned in nearly 50% of the replies were surveying, geology and mining. A significant number of respondents listed milling, assaying, drafting and report writing. About 25% expressed a desire for more training in the use of computers. Some respondents expressed an interest in instruction in blasting and the mining act and regulations.

Graduates of Haileybury frequently mentioned that the present mining program should be altered so that a student could choose to specialize in one of three options during the third year - mining, geology and mineral processing. Other comments made by more than one respondent included revising courses to make it easier to proceed to university and up-dating the courses to teach new mining and milling practices.

## 4.3 Recent Changes in Programs at Universities and Colleges

Information was sought from two universities and two colleges concerning changes in programs during the last five years and changes proposed over the next five years.

Queen's has added the following courses to its curriculum during the last five years - advanced course in rock mechanics, expert systems (artifical intelligence), mine maintenance, electronics, reaction kinetics and occupational health and safety. All students are encouraged to purchase a personal computer. Additional options in advanced mine maintenance, robotics and automation will be added when funds are available.

Laurentian has recently added two faculty members which will make it possible to add courses to the curriculum. Laboratory facilities have been upgraded to improve the quality of instruction in some courses. Laboratory space, equipment and library facilities are still considered inadequate.

Cambrian has improved and rearranged its geology courses. The rock mechanics course was changed to one section of theoretical rock mechanics and one of practical ground control. Computer programming has been upgraded and computer applications have been added to mine planning and drafting courses. A course in mine machinery was added. Cambrian also plans to provide more computer training and add courses in computer modelling for ground control and borehole geophysics. The funds for these changes are expected to be received next year.

Haileybury has added ground control to the mining course, revised surveying, increased the instruction of hydraulics, added a power generation and distribution course, and upgraded the chemistry course. When funds become available, Haileybury plans to introduce the use of the latest equipment in surveying and chemical analysis. Plans are also underway to implement a new one-year course - mineral exploration assistant.

## 4.4 Recommendations

4.4.1 Courses in occupational health and safety, maintenance and management skills should be increased in range and frequency.

# V EFFECT OF FUTURE CHANGES IN TECHNOLOGY

## 5.1 Nature Of Technological Change

Companies expect that major changes in mining methods will continue to occur over the next several years. Closer attention is being paid to improving metal recoveries and control of mill effluents and wastes. New technologies will be developed and applied in both new and existing plants. The use and maintenance of equipment such as computers and on-stream analyzers for the purpose of process control, will become even more important knowledge than it is today. This will lead to even more sophistication in the mine process.

The competitive conditions now faced by the industry are expected to continue and may even increase in intensity. Engineers and technologists will be expected to have a better understanding of the need for cost controls in operations as well as methods for evaluating the economics of new plant expenditures.

## 5.2 Effect Of Change

Flatter organizational structure will place more emphasis on management skills while a more knowledgeable work force will necessitate changes in mangement - employee relations.

As the current changes in the structure and nature of the work force accelerate, universities and colleges will face two challenges: they will have to modify their undergraduate and graduate programs to keep abreast of new technology, and they must be prepared to offer short courses to retrain engineers and technologists already working in the industry.

The necessary modification of undergraduate and post-graduate programs will present institutions with some difficult choices. Each time something new is added to a program, it may be necessary to delete something already now being taught. Since the rate of change in technology will vary considerably from one mine to another, the needs of graduates and industry will be best served by offering programs which provide students with a solid knowledge of engineering principles combined with courses designed to teach students how to apply these principles in a variety of specific situations.

## VI CONTINUING EDUCATION

### 6.1 Upgrading And Retraining

About fifty percent of companies surveyed indicated that the skills possessed by their current staff are adequate. Nevertheless, replies indicated that knowledge is deficient in some areas and should be improved.

The main deficiences, in order of importance, were reported to be computer skills, rock mechanics, remote process controls, environmental controls, human relations, production engineering, statistical process control and maintenance of equipment.

Nearly all respondents reported that training programs should be carried out both within the companies and by universities and colleges.

### 6.2 Current Programs Available

During the past year, Queen's offered short courses at the university in drilling and blasting, applied slope engineering, explosive technology, industrial hazard analysis, mine design and operation and mine maintenance engineering. A total of 100 attended the courses. Queen's expressed a desire to offer more courses and is considering ways to increase interest and attendance. Consideration is being given to offering some courses in Sudbury with the cooperation of Laurentian. In addition, the use of the Northern Ontario Distance Education Access Network is being investigated.

Laurentian offered short courses in rock mechanics and mine ventilation attended by a total of forty-two persons. These courses were

offered in cooperation with Inco Ltd. and were designed for mine managers, superintendents and engineers.

Cambrian offered short courses in occupational health, hazardous materials, and advanced first aid. These courses were attended by 347 people. In addition, a special rock mechanics seminar was attended by 70 persons. Evening courses were offered in rock mechanics, mine ventilation, chemistry, ferrous metallurgy and mineral processing. Total enrollment was 113 persons. All of the courses were conducted on the campus but Cambrian expressed a willingness to hold courses at other locations if there is a demand. Cambrian has also conducted courses specifically designed for one company in cooperation with the company. An example is the course in cost control being conducted for employees of Falconbridge Ltd.

Haileybury offers short courses in ground control and ventilation once a year in conjunction with, and assisted by, the Mines Accident Prevention Association of Ontario.

All the institutions indicated a desire and willingness to offer more courses because they generate additional revenue which can be used for equipment purchases and for funding the attendance of instructional staff at conferences which helps to keep staff up to date. Expansion of course activities appears to be inhibited because the market is difficult to identify and the expense of advertising renders poorly attended courses uneconomical. From the interviews with companies and unions, it is apparent that the demand for short courses and continuing education could be increased by greater efforts on the part of institutions to determine the needs of potential students by responding to more specific requests for training from the industry and by offering such programs off campus.

## 6.3 RECOMMENDATIONS

6.1.1 Universities and colleges should work more closely with industry to determine the needs for short-term non-credit courses aimed at up-grading the knowledge and skills of industry personnel. They should be prepared to deliver such courses at the home campus, at remote locations, by correspondence or by distance education facilities, as may be appropriate.

## VII Training in Rock Mechanics and Ground Control

### 7.1 Current Status

The Committee was asked to consider the recommendations concerning "Post Secondary Education" in the "Report of the Provincial Enquiry into Ground Control and Emergency Preparedness in Ontario Mines". Discussions were held with academic institutions on this matter.

Both universities and colleges agreed unanimously that staff members teaching rock mechanics should have strong practical experience in hard rock mining. The institutions stated that their current staff had adequate practical experience.

Qualified persons from the mining industry do participate in teaching short courses in rock mechanics but the practice is not widespread, and does not appear to exist for undergraduate programs.

### 7.2 Improving Programs

It has been announced that the Ministry of Northern Development and Mines will provide funds to establish a chair in Rock Mechanics and Ground Control at Laurentian University and expects to fill it shortly. An agreement is being made with Queen's to appoint the incumbent to the staff at Queen's as well as Laurentian and for the two universities to cooperate on rock mechanics research and training. Consideration is being given to including University of Toronto in the program. In addition to this, the universities reported that they are attempting to raise funds to finance the following additions to improve rock mechanics research and training:

Queen's - a chair in Mine Design, to increase the emphasis of rockburst control through mine design.

U. of T. - add a staff member with extensive practical experience in the Canadian mining industry.

Waterloo - creation of a centre for education and research in rock mechanics.

Cambrian - add 2 additional staff members and equipment to teach ground control courses to technical personnel in mines throughout the province.

One university has already increased the emphasis of improved backfill technology and instrumentation systems as means of achieving ground control.

It would seem that the universities have adequate facilities and staff to train people seeking post-graduate degrees in rock mechanics. Each university has some specific areas of interest; combined they cover a wide range. The universities and CANMET are undertaking several research projects now, financed in part by mining companies.

As a means of upgrading skills in rock mechanics and ground control, a number of short courses have been offered. For instance, during the 1985-86 academic year, Laurentian, Cambrian and Haileybury offered short courses in rock mechanics and ground control designed for specific groups in the industry. Attendance at the courses totalled 166 engineers, technologists and supervisors. These courses were held at the institutions. The universities and colleges are willing to conduct short courses in remote locations if requested by mining companies. They pointed out, however, that delivery in remote locations would be less than satisfactory when the instruction requires the use of laboratory equipment to be fully effective.

## 7.3 RECOMMENDATIONS

7.3.1 Each university and college should designate a person to determine the nature and scope of short courses in rock mechanics and ground control which are required to train engineers, technologists and workers employed currently by the industry.

7.3.2 The universities and colleges should design courses to specifically address the training needs for each type of employee. Delivery of the courses should accommodate the convenience of the mining companies as far as possible, having regard for the facilities required for instruction and number of attendees available.

## VIII Employment of Engineers and Technologists as First-Line Supervisors

### 8.1 Industry's Attitude:

During the early stages of the review, it was suggested by some company representatives that companies, in time, would employ engineers or technologists to fill all first-line supervisory positions. If this were to occur, the demand for graduates would increase significantly. For this reason a question was included in the company questionnaire to test the reaction of the industry.

The survey question asked:
"Some people in the mining industry have suggested that first line supervisors should be engineers or technologists. Do you agree or disagree? Please elaborate on your reasons."
The responses to this question varied. Four companies agreed and eleven companies disagreed. Nine companies agreed or disagreed in part.

Several companies commented that graduates should be assigned as first-line supervisors for a time to develop their management skills. These same people expressed the belief that they would not be willing to remain in such a position for long. Furthermore, a few companies indicated that engineers are often poor managers of people and therefore perform unsatisfactorily in first-line positions. It was also stated by one respondent that technologists make better first-line supervisors than engineers.

One respondent, who agreed with the question, stated that all their first-line supervisors are now either engineers or technologists. Three respondents who agreed said that they will increase the numbers of technologists and engineers in supervisory positions over time. They believe that the emphasis will be increasingly on the technical supervision of machines and systems rather than people.

Two respondents reported that they are employing a management system that does not employ first-line supervisors in the traditional role. Instead, "coordinators" of work groups are being introduced.

The committee makes no recommendations with respect to this question. As stated earlier, the opinions were sought to determine whether such a move would affect the future demand for graduates. It was thought that a summary of the replies would be of interest to the mining companies.

## IX WORK EXPERIENCE

### 9.1 Importance Of Work Experience

Every respondent to the company questionnaire stated that work experience during undergraduate years was either very important or important to the training of engineers and technologists. The universities agreed that work experience is very important to complement academic instruction and have made it a requisite for granting a degree. The colleges also regard work experience as very important, since a significant number of students enroll in their programs after having been in the work force.

Comments from recent graduates indicated a strong desire for more and better opportunities to gain related work experience during their academic careers. The desire for a "Co-op" type program was expressed by a significant number of both university and, particularly, college graduates.

### 9.2 Methods To Increase Work Experience Opportunities

In reply to the question, "how can additional opportunities be made available?", a number of ideas were advanced. Government financial incentives for companies was mentioned most frequently. Closely followed, was the adoption by mining universities and colleges of the "Co-op" scheduling of academic and work terms, as practiced by the University of Waterloo. Some companies suggested that the Ontario Mining Association should assist the companies to devise practical ways to provide meaningful summer employment to complement their academic studies. As well, unions should be consulted with a view to removing obstacles which exist in some companies under terms of collective agreements.

A few respondents expressed the view that companies should be prepared to provide planned programs of employment in several sections of the operation, even though this might entail additional costs for the company. Because many companies suspend operations during the summer, three companies suggested a company might be prepared to pay a student to undertake a research project of use to the company. The work could be done at the university or college under direction of a staff member of the institution. At least one university agreed that this is feasible.

Both the universities and colleges stated that they do make an effort to place students in related summer employment. One or more of the staff members call mining companies seeking opportunities for employment of those students who have been unable to find employment through their own efforts. This involves time which ordinarily would be devoted to teaching and related activities.

The University of Waterloo has been placing some students in the Ontario industry in conjunction with their "Co-op" plan. These are generally students in the mechanical, electrical and geological engineering programs. The companies which have participated support the program strongly.

The possibility for introducing the Co-op plan in mining programs was discussed with the four universities and colleges. All said the system has merit but has not been adopted for a variety of reasons. Queen's replied that it could not be introduced for the mining programs unless it was adopted by the whole faculty of engineering. This was due to the difficulty of scheduling courses offered by other departments to students in the mining program. In any event, Queen's experience indicates that all students obtain related summer employment now, which will assist them in achieving additional work experience. Laurentian intends to give some consideration to implementing a modified "Co-op" program when accreditation is received.

One institution has considered the system but has not adopted it because they do not believe that the necessary industry cooperation would be forthcoming. They feel that the companies are not keen to cooperate when production is high and are reluctant to pay the cost when production is low. Haileybury has considered instituting the system but concluded that enrollment in their programs is too small to be able to operate effectively. They believe they could do it if they could develop more research work and other teaching activities to engage the additional staff to provide for the summer term. Haileybury believes that all of its students do obtain summer employment but estimate that 25% percent are employed at work not related to the courses being studied.

It has recently been announced that the mining programs at McGill University and École Polytechnique will be combined and operated on a "Co-op" system very similar to the one practiced by the University of Waterloo. This might appeal to prospective mining engineering students.

In view of the strong interest shown by companies and recent graduates in reinforcing the quality of work experience, the universities and colleges should seriously consider how this can be accomplished.

## 9.3 RECOMMENDATIONS

9.3.1 The universities and colleges should actively consider ways in which they can contribute to improving the work experience component of their programs.

9.3.2 To this end, each institution should appoint a resource person, either full or part-time as appropriate, to stimulate and coordinate the work experience component.

9.3.3 Ontario employers and government should recognize the importance of work experience in the training of students and devise ways to provide meaningful employment opportunities for students. One or more members of a company's staff should be designated to liaise with students during the work term.